

# SUMMARY REPORT FY 2001



### **FRONT COVER**

- A. Inversit Bridge Erection, I-70 St. Louis
- B. Virgin aggregate being dumped into motor paver on Rt. Z Randolph County, District 2. As it goes through the machine, it is pugmilled and is laid as a cold mix.
- C. Ashli Houchins, Summer Intern, is on the south of highway 35 in Ralls County. She is preparing to take a reading with a GPS unit, on the compass plant (*Silphium laciniatum*) in front of her. The GPS unit will store a record for the compass plant at the UTM coordinates where she is standing. This record can then be transferred from the unit to the GIS workstation in the office and plotted on a map.
- D. New PCCP Pavement Design. The pavement is Missouri's first new jointed plain concrete design on 2' rock base built in the southbound lanes of US 54, just north of Jefferson City. It was constructed just after the flood in 1993.



## RESEARCH, DEVELOPMENT AND TECHNOLOGY

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Everyone in the transportation industry is faced with the growing travel demands for people and goods. This demand requires that state transportation agencies must be ready to meet the needs through ever-changing technologies and practices. The Research, Development and Technology (RDT) unit of the Missouri Department of Transportation plays a major role in identifying, researching, developing and in sharing new and innovative technologies for the Missouri transportation system.

Changing demands have required MoDOT and RDT to change as well. As a service unit, RDT is committed to providing services throughout the department. Fiscal Year 2001 has seen RDT providing services to a larger segment of the department.

A recent important change incorporated is an added emphasis on policy research. Senior management usually generates policy research. These research requests come with specific needs and time schedules that may not be associated with other applied research. RDT has adopted the principles from the National Cooperative Highway Research Program's Synthesis of Practice 280, *Seven Keys to Building a Robust Research Program*, to be responsive to research, development and technology transfer needs throughout MoDOT.

A major change in RDT operations came about with the implementation of Technical Advisory Groups to assist the administration of research, new product development, implementation of research, new products and best practices, and in technology transfer of the advances. Technical Advisory Groups (TAG's) have been formed in the technical areas of Project Development/Bridges, Operations, Pavements, Geotechnical, Traffic/Safety, New Products and Social/Economic/Environmental studies. These areas are more technically identified than the original focus areas of System Preservation, Safety, Innovation, Traffic Mobility and Social/Economic/Environment.

The TAG's are made up of representatives from MoDOT business units and districts and from the University of Missouri, Columbia and Rolla campuses. The role of the TAG's is to identify, review and prioritize research and new product ideas, to review draft and final reports and to make recommendations to the RDT Administration Team. Cooperation between MoDOT and the University of Missouri system is facilitated through a partnering agreement for the purpose of collaborating common efforts in transportation-related research, education and communication. This partnership is referred to as the MOTREC, Missouri Transportation Research and Education Center. RDT also uses a Technical Review Committee to provide two-way communication between RDT and MoDOT business units and districts. Technical Review Committee members are select MoDOT staff members serving on a Technical Advisory Group and on business unit or district management teams.

*RDT is here to help you make wise transportation choices. If you need a solution to a challenge, give us a call at (573) 751-3002 or visit us at [www.modot.state.mo.us](http://www.modot.state.mo.us). We can help you!*

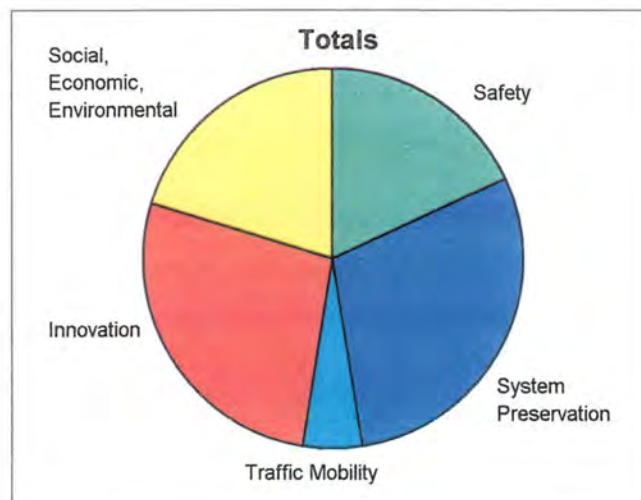
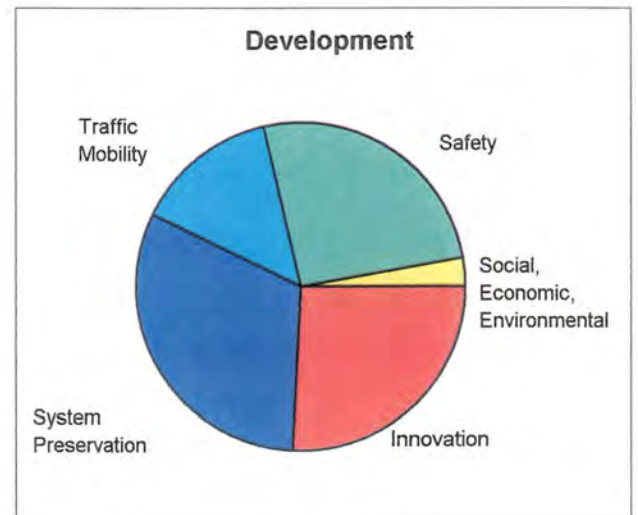
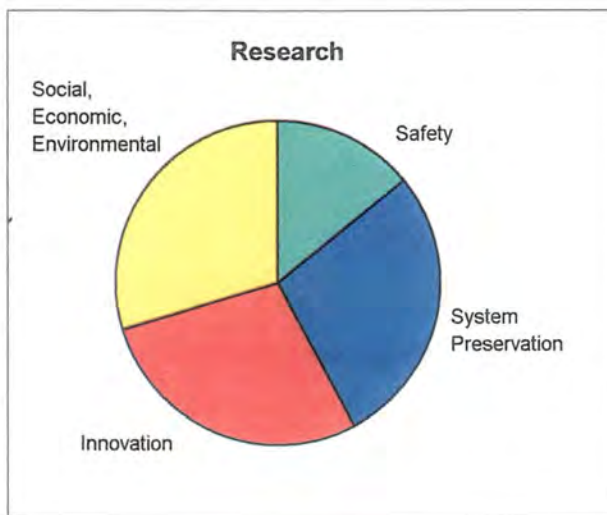
*You will find a New Product Evaluation Form and a Research Idea Statement Form located at the end of this report.*

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## RESEARCH IDEA STATEMENTS RECEIVED

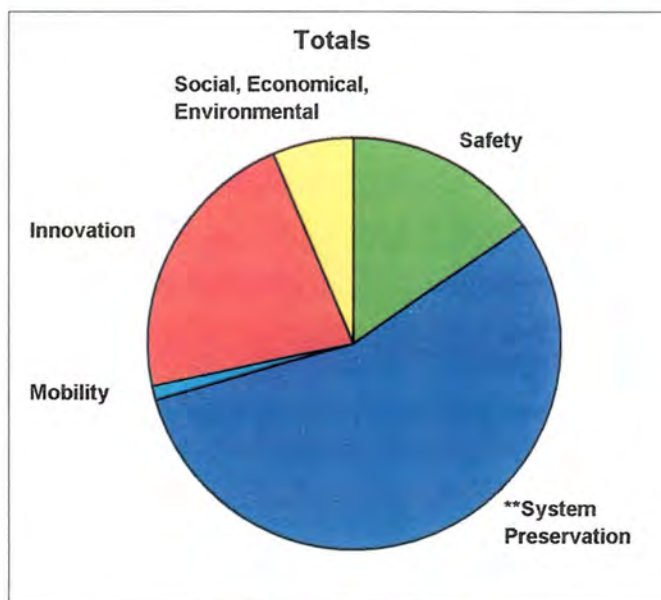
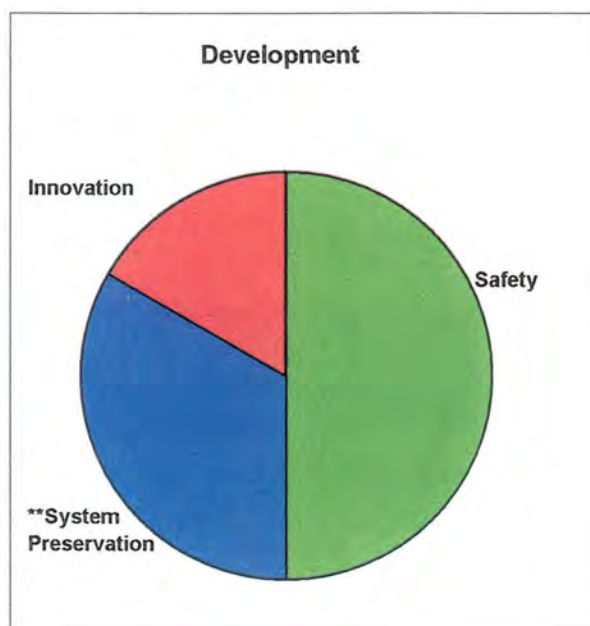
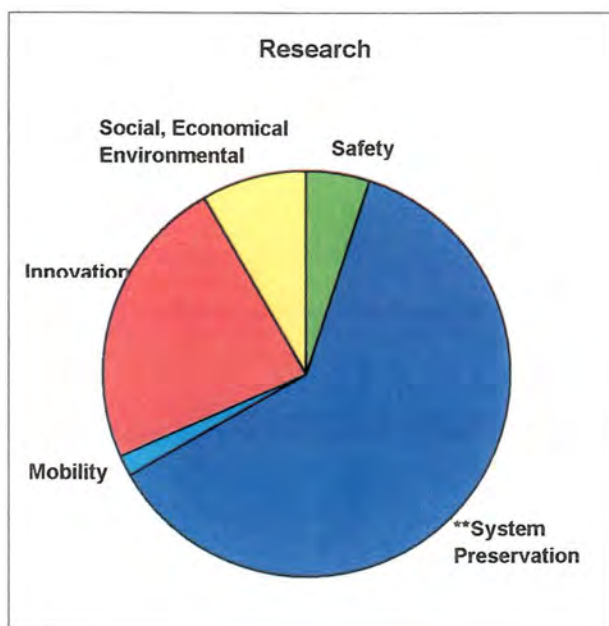
|             | Total | Safety | System<br>Preservation | Traffic<br>Mobility | Innovation | Social<br>Economic<br>Environmental |
|-------------|-------|--------|------------------------|---------------------|------------|-------------------------------------|
| Research    | 64    | 9      | 18                     | 0                   | 18         | 19                                  |
| Development | 35    | 9      | 11                     | 5                   | 9          | 1                                   |
| Total       | 99    | 18     | 29                     | 5                   | 27         | 20                                  |





## RESEARCH AND DEVELOPMENT IN PROGRESS AND COMPLETED

|                    | Total | Safety | Preservation | Mobility | Innovation | Social<br>Economical<br>Environmental |
|--------------------|-------|--------|--------------|----------|------------|---------------------------------------|
| <b>Research</b>    | 60    | 3      | 37           | 1        | 14         | 5                                     |
| <b>Development</b> | 18    | 9      | 6            | 0        | 3          | 0                                     |
| <b>Total</b>       | 78    | 12     | 43           | 1        | 17         | 5                                     |



\*\*System Preservation contains Research and Development in system rehabilitation, system reconstruction and preventative maintenance activities.

## RESEARCH

The research emphasis is the first step in putting a new product or procedure on the road. Research is a word used for a broad range of tasks, but at MoDOT, research essentially means physically investigating products or concepts to see what the possibilities are. Through research, MoDOT can improve policies, procedures and operations that provide a more cost-effective transportation system.

## SYSTEM PRESERVATION

### RI91-001 – SHRP Long Term Pavement Performance (LTPP) Program

**Project** - The main objective of the LTPP program, a nationwide 20-year study coordinated by the FHWA, is to investigate various designs of pavement structures and rehabilitated pavement structures, using different materials and under different loads, environments, subgrade soil, and maintenance practices. General pavement studies (GPS) and specific pavement studies (SPS) test sites were built nationwide. MoDOT has built 11 SPS sites and 20 GPS sites from which data continues to be collected.

**Savings** - This study is expected to determine cost-effectiveness of different construction, rehabilitation, and maintenance strategies.

**Status** - Missouri has actively participated in the LTPP program since its initiation in 1987. The LTPP program will continue to collect and monitor data from the pavement studies until final conclusions can be made. Initial findings from the LTPP program have been presented in TRB and FHWA reports and technical briefs.

### RI91-011 – Missouri Culvert Study

**Purpose** - The objective of this study is to conduct field inspections on various culvert materials, both conventional and those considered experimental, used throughout the state. The study primarily includes collecting field performance data on metal, reinforced concrete and polyethylene pipes.

**Savings** - This project will provide valuable performance data concerning the performance of various pipe materials, and how geographic location and conditions will affect performance of those pipe materials. As a result, MoDOT can provide guidance on identifying the most cost-effective pipe materials to be installed according to field conditions and location.

**Status** - A report, *Culvert Study Report* (RDT00-004), assessing Missouri's past culvert study efforts and summarizing overall pipe performance, was published in August 2000. Efforts to continue monitoring the performance of Missouri's various culvert materials are ongoing.



## RI92-004 - Statewide Study of Cathodic Protection (CP) Systems

**Purpose** - The objective of this study is to provide guidance for MoDOT's program for cathodic protection of bridge decks as well as looking at new CP technology. A cathodic protection team with members from six different business units administers this program.

**Savings** -Cathodic protection is the only known means to stop corrosion of uncoated steel reinforcement. It will remain an option for rehabilitating existing bridges as long as uncoated bars remain in bridges or until alternate reinforcing materials are practical enough to replace steel. Besides the eighty bridge decks using impressed current systems, two projects using galvanic or passive anodes (no AC power is needed to run the system) were initiated this year. A surface-applied 3M Zinc-Hydrogel Anode, a zinc coating using a conductive adhesive, was used on the outside of pier caps on two bridges that had just received extensive concrete repairs. The reinforced concrete piers should be protected indefinitely; the system itself can be replaced after seven to ten years if needed. A second project is underway using Vector Galvashield XP Anodes, embedded galvanic anodes, in reinforced concrete bridge deck repairs. These anodes should prevent any ring corrosion effect caused by the new concrete patches and protect them for up to twenty years.

**Status** – The Zinc-Hydrogel project will be monitored until 2004 and the Galvashield embedded anodes will be monitored until 2006 to determine their effectiveness in halting corrosion of the rebar and the soundness of the concrete patches they are protecting.

## RI92-007 - Bridge Deck Condition Surveys

**Purpose** - The objective of this study is to conduct condition surveys on bridge decks



scheduled for rehabilitation. The condition surveys identify the type and extent of deterioration, which is needed to estimate rehabilitation quantities and costs during the design process.

**Savings** – Accurate estimates of quantities of repair will avoid large bid amount overruns that drive up contract costs from the original bid.

**Status** – In the last year, a computer program has been written to automate reporting of the inspection data and to store

all test data in a historical database. This is an ongoing study.



## **RI96-005 - Evaluation of Pavon "In-Deck" Seal for Cracks in Bridge Decks**

**Purpose** – This study evaluates the effectiveness of this polymer asphalt emulsion to fill small cracks in bridge decks, to prove how far it migrates into the cracks and how effectively it seals moisture out.

**Savings** – It is more effective than annually pouring cracks with oil and in keeping the moisture and salt from reaching the reinforcing steel causing corrosion and costly concrete repairs.

**Status** - RDT Completed and distributed the final report, *Pavon Indeck Crack Seal* (RDT00-012), in September 2000. Results to date indicate that Pavon "In Deck" is a cost effective means of sealing cracked bridge decks.

## **RI97-009 – Metallic Dampers for Seismic Design and Retrofit of Bridges**

**Purpose** – The purpose of this study was to develop an economical solution for the design and retrofit of continuous steel girder bridges in low occurrence seismic zones like the central and eastern United States. Metallic dampers are used to dissipate in a controlled manner, the energy imposed on a bridge during a seismic event. Without seismic dampers or other types of retrofitting schemes, older bridges (approx. pre 1975) may be vulnerable to catastrophic damage as unconfined plastic hinges may form in the columns.

The scope of work included optimization of metallic dampers, experimental study of the cyclic behavior of full-scale dampers, experimental study of the dynamic behavior of high rocker bearings and dampers installed in a small-scale bridge system, and analytical development of a simplified procedure to account for the pounding effect in the response spectrum analysis of highway bridges.

**Savings** - The quantitative savings incurred by using metallic dampers is not easily defined as the cost of retrofitting bridges can be accurately estimated only on a case-by-case basis. Conventional retrofits may include restraining systems, steel jacketing of columns, enlargement of columns and/or footings, and the use of drilled shafts or pin piles on a foundation. In addition to the materials and installation costs, other costs such as shoring, excavation, traffic control and the like may make a conventional retrofit economically unattractive. In these situations the metallic dampers would be an economical alternative since the dampers minimize the inertial forces transferred to the bridge substructure and can be installed relatively quickly and without excessive disturbance to the existing bridge and/or traffic.

**Status** – A report, *Metallic Dampers for Seismic Design and Retrofit at Bridges* (RDT01-005) was published in May 2001.

## **RI97-015 – Evaluation of Fiber-Reinforced Unbonded Portland Cement Concrete Pavement (PCCP) Overlay**

**Purpose**-The purpose of this study is to evaluate the effectiveness of a fiber-reinforced unbonded PCCP overlay as a pavement rehabilitation strategy. The addition of fibers in the concrete leads to improved properties like crack propagation resistance, ductility, impact resistance, fatigue performance and durability. A fiber-reinforced unbonded PCCP overlay was built on Interstate 29 in Atchison County in 1998. Test sections were established with either steel or polyolefin fibers, at varying depths with varying transverse joint spacing. The overlay was diamond ground at least 21 days after construction to provide texture and a smooth surface.

**Savings**-The improved properties of the fiber-reinforced concrete are expected to lead to a longer lasting pavement, which requires less maintenance than a conventional overlay.

**Status:** A report, *Evaluation of Fiber-Reinforced Unbonded Overlay* (RDT00-15), was published in December of 2000, and details the construction and the one-year performance data of the fiber-reinforced unbonded overlay. Annual pavement surveys continue to be completed and additional pavement performance update reports will be written.

## **RI97-020-Cracking in Bridge Barriers**

**Purpose** - Based on reports from district and bridge crews, this study started with the objective "to determine the cause of excessive cracking of bridge safety barrier curbs." The current bridge rail design is a New Jersey shaped safety barrier with a cage of reinforcing bars. Common practice is to slip form this barrier using a concrete mix that is stiff enough to support the three-foot wall height and then to use wetted burlap for curing. Problems with both slip-forming and wet burlap curing have been noted and are suspected of causing excessive cracking in the barriers.

**Savings** – Cracks in bridge safety barriers are a concern because premature failures increase maintenance, trigger other failures, and shorten the entire structure's life. Problems may also indicate MoDOT is not receiving the quality of construction that is being paid for, structurally or aesthetically. These failures have costly consequences and represent a potential savings if they can be prevented at a reasonable cost. The potential for net savings can be determined once the cause, the prevention needs, and the prevention costs can be identified.

**Status** - A final report should be available winter 2002.

## **RI97-021 – Precast I-Girder Cracking: Causes and Design Details**

**Purpose** – The objective of this study was to partner efforts with the University of Missouri – Columbia and University of Missouri – Rolla to investigate the cause, determine mitigation procedures if necessary, and provide recommendations for



eliminating the future occurrence of observed cracking in Missouri prestress precast concrete structural I-girders.

**Savings** – This project will provide information on design, fabrication and in-service issues concerning precast I-girders for improved performance and service life.

**Status** – A report prepared jointly by the University of Missouri – Columbia and University of Missouri – Rolla, *Precast I-Girder Cracking: Causes and Design and Design Details*, (RDT01-008).

## RI97-024 – Two-Foot Rock Fill Study



**Purpose** – To determine the advantages of the two-foot rock fill base under Asphaltic Concrete (AC) and Portland Cement Concrete (PCC) pavements. Currently, Missouri design standards call for alternate base course designs, the daylighted two-foot rock fill or the four-inch Type 5 material with edge drains and with or without a four-inch permeable base above.

**Savings** – Cost savings will be realized from selecting rock fill if it is

determined to provide greater structural support and better drainage than the alternate bases.

**Status** - A final report should be available in late 2001.

## RI97-025 – Hydro-Demolition and Repair of Bridge Decks



**Purpose** - The objective of this study is to observe bridge decks being repaired using hydrodemolition to determine if this procedure is less destructive to bridge decks and more cost efficient than present mechanical preparation methods.

**Savings** - Hydrodemolition is less harmful to the concrete that will remain in place, causing fewer failures of patches in the future. Hydrodemolition removes all the deteriorated

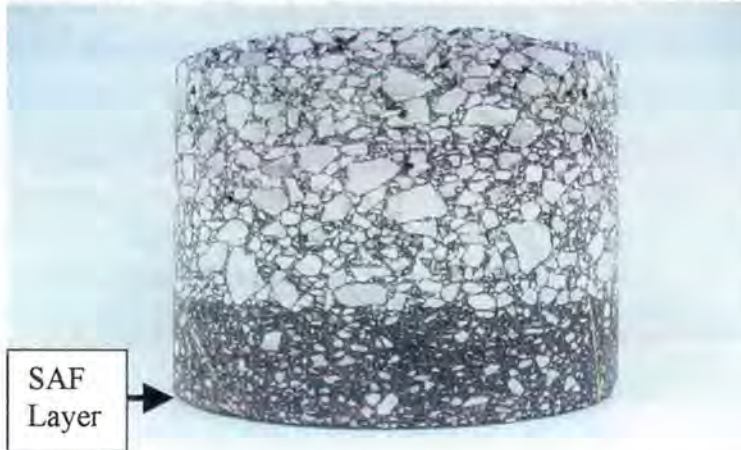
concrete and cleans the reinforcing steel so when debris is removed the deck is ready to be patched and overlaid with concrete. This eliminates steps of sandblasting and continual cleanings needed when using conventional methods. Additionally, if patching and applying the overlay are done at the same time, even more time and labor can be saved.



**Status** – Several bridges being repaired by hydrodemolition have been observed and testing data has been collected. A final report will be available fall 2001.

## **RI97-045 & RI99-042 – Sand Anti-Fracture (SAF) Overlaid with SuperPave**

**Purpose** – This study was to evaluate the effectiveness of a one-inch fine graded asphalt mixture using highly polymerized asphalt cement with a high asphalt content and low air voids. This mixture is proposed to retard reflective cracking in asphalt overlays of



Portland Cement Concrete pavements. An SAF interlayer has been placed on two construction projects: RI97-045, I-29, Holt County ('98) and RI99-042, Rte. 36, Dekalb County ('00).

**Savings** – The benefits anticipated from the SAF layer are from the reduction of initial pavement repair costs, possibilities of a reduction in overlay thickness and a longer

lasting service life of the asphalt overlay. The material cost of the SAF layer is approximately \$20,500/lane-mile. The benefit of using the SAF layer remains to be determined through field research and performance.

**Status**- A construction report for the Rte. 36, Dekalb County project, was published, *U. S. Hwy. 36 – Syperpave Overlay of Sand Anti-Fracture Layer Over AC/PCC Pavement* (RDT00-001B). A third-year performance update for the SAF test sections constructed on I-29, Holt County, was completed in August, 2001. A final report for I-20, RI97-045 and Rte. 46, RI99-042, should be completed in 2003 and 2005, respectively.

## **RI98-007 – Soil Stabilization Using Recycled Plastic Pins**

**Purpose** – The primary objective of this University of Missouri–Columbia study is to develop recycled plastic pin technology for use in stabilizing transportation facility slopes. This will be accomplished by evaluating the suitability of using recycled plastic pins for stabilization and remediation of highway slopes and embankments; developing procedures and equipment for design and construction of recycled plastic pins stabilization schemes; and evaluating the economics of recycled plastic pin remediation schemes as compared to other remediation options.

**Savings**- Current costs incurred by MoDOT for the repair and stabilization of shallow slope failures are significant. Stabilization of these slopes with recycled plastic pins promises to provide a cost effective measure for permanent stabilization, providing direct savings for stabilization as well as eliminating the recurring costs associated with repetitive stabilization of slopes using less costly methods.



**Status-** A report on Phase 1, *Soil Stabilization Using Recycled Plastic Pins - Constructability* (RDT00-007), demonstrating the constructability of using plastic pin technology for stabilization measures, was published in July 2000. Phase II, which addresses issues of applicability and validation, is currently underway.

## **RI99-001 – Use of High Performance Concrete (HPC) in Inverset Bridge System**



**Purpose-** The Inverset Bridge System is an innovative approach to design and construction of roadway bridges. The bridge is of modular construction and uses both steel I-girders and concrete to form composite units. Because the units can be cast off-site, preparatory work can be done simultaneously on-site so that construction time is reduced. The units are cast upside-down and allowed to deflect a predetermined amount. When the finished units are placed in their proper

orientation on the bridge substructure, the units' own weight places the concrete in compression. This natural prestressing should reduce the amount of cracking in the bridge deck. The concrete, or deck portion of this bridge, located on Adelaide Avenue over I-70 in St. Louis City, is made of high performance concrete. The HPC is designed to be more resistant to penetration of chlorides than conventional concrete.

**Savings-** The faster construction of the Inverset bridge should provide a savings in user delay because of reduced bridge closure times. The HPC, coupled with the Inverset technology, should result in a long lasting bridge that requires little maintenance.

**Status-** Construction of the Inverset bridge on Adelaide Avenue was completed in the winter of 2000/2001. A construction report will be completed by winter 2001.

## **RI99-012 - Evaluation of Ultra-Thin Whitetopping (UTW)**



**Purpose -** To determine the constructability and evaluate the effectiveness of placing an ultra-thin whitetopping overlay as a means of pavement rehabilitation, (at the intersection of Belt Highway and Route YY in St. Joseph and on Route 60 in Neosho).

**Savings -** The UTW with fast-track characteristics should last two to three

times longer than asphalt overlays and will reduce the construction time required.



Reducing the construction time and providing a longer lasting pavement will minimize traffic delays and safety risks.

**Status** - Both projects will be monitored on a yearly basis. An initial report on the St. Joseph UTW project should be available in the fall of 2001.

## **RI99-022 – New Portland Cement Concrete (PCC) Pavement Design Study**



**Purpose** – To evaluate the effectiveness of the new PCC pavement design. The new PCC pavement design was first initiated in 1993. The new design utilizes unreinforced concrete, 15' joint spacing with dowel bars, 14' wide paving in the driving lane, tied shoulders, and greater slab thickness. The old design utilized reinforced concrete, 61.5' joint spacing, with dowel bars, 12' wide paving in the driving lane, and no tied shoulders.

**Savings** – Elimination of early distresses found in the older pavement design will increase the expected design life of the new PCC design.

**Status** – An initial report should be available in September 2001. Follow up reports are anticipated every three years through 2009.

## **RI99-026 and RI00-059, High Performance Steel**

**Purpose** – There are currently two studies underway with the University of Missouri-Columbia to conduct laboratory testing and field evaluation of high performance steel (HPS), grade 70W, used in bridge I-girders: RI99-026 – Shear Tests of HPS Hybrid Girders and RI00-059 – Evaluation of Performance and Serviceability of HPS Girders. HPS, in lieu of convention steel, offers higher strength, increased toughness and improved weldability. These studies have been initiated to investigate and provide data concerning tension-field action limitations of HPS for improved design specifications, and to provide performance evaluation data focusing on HPS strength and serviceability aspects, particularly live load deflection criteria.

**Savings** - Utilizing HPS as a component in a hybrid girder design allows the use of HPS in only the highly stressed regions (with conventional steel, grade 50W, in other regions) and results in a more economically designed bridge.

**Status** – Both projects are currently active. Investigation RI99-026 is expected to be completed in spring 2002 and investigation RI00-059 in fall 2002



## **RI99-033 – Evaluation of Early Entry Sawing**

**Purpose** - Early entry concrete saws allow the placement of control joints in concrete at an early age before internal stresses are very large. For this reason, the joints may be sawed at shallower depths than those sawed with conventional saws. Preliminary tests have produced good joints with a higher production rate (ft/saw/hr) than conventional sawing.

**Savings** - The production rate with the early entry saws should yield a project cost savings. The shallower joint depth may lead to longer saw blade life, although this has not yet been proven.

**Status** - An initial letter of findings for the first project was prepared in October 1999. Two additional locations were studied with a formal report to be published in the late summer of 2001.

## **RI00-001 – Addition of Water Reducers to PCCP Mixes**

**Purpose** – The objective of this study is to determine the potential benefits and cost savings of adding a Type A water reducer and reducing cement content in MoDOT's PCCP mixes. As a result of adding water reducer to PCC paving mixes, it is proposed that the cement content and mixing water can be reduced. It is also proposed that adding a water reducer will promote complete hydration of the cement particles resulting in an improved hardened concrete product in terms of strength, durability, and performance.

**Savings** – Two PCCP projects implemented the water reducer. The estimated cost savings of these projects averaged \$0.40 per cubic yard of concrete. There is also an economical benefit in reducing cement content in PCCP mixes by using less resources and being more environmental friendly.

**Status** – An interim report, *Water Reducing Admixtures in PCCP Mixes* (RDT01-004), for one PCCP project and laboratory work was completed in March 2001 (RDT01-004). A final report including the second PCCP project should be available by December 2001.

## **RI00-008, Evaluation of Pavement Preservation and Rehabilitation Strategies**

**Purpose** – This study was to provide guidance for the selection of cost-effective preventive maintenance and rehabilitation strategies. All feasible rehabilitation and preventive maintenance techniques will be evaluated for applicability to the state system. Existing performance data will be analyzed and developed into trends. Performance information not readily available from Missouri locations will be used from outside sources. Firm recommendations for the implementation of these strategies in design, construction, and maintenance will be given. The impact of these strategies on the short and long range planning process will also be evaluated.

**Savings** – Optimizing the design lives and construction/operating costs of Missouri pavements will provide widespread savings.

**Status** – A final report should be available in late 2001.



## RI00-019 – Soil Stabilization with Fly Ash

**Purpose** - The purpose of this study is to evaluate the benefit to initial pavement smoothness of various base and subgrade designs. An improved subgrade is expected to lead to improved pavement construction and initial pavement smoothness. Test sections that are modified with fly ash or lime will be compared to a control section with Type 5 base and a control section with two-foot rock base.



**Savings** - The initial smoothness of a pavement is believed to contribute to a longer lasting pavement requiring less maintenance than a rougher pavement. The reduced maintenance and repair costs, along with the expected longer life of the pavement, will offset the cost of subgrade modification and likely to lead to a lower life cycle cost.

**Status** - A work plan and special provisions for this project on Route 36 in Caldwell County were prepared in FY 2001. Construction of the test sections began in June of 2001.

## High Performance Concrete (HPC)

**Purpose** - High Performance Concrete is concrete with enhanced properties, such as strength or durability, designed to optimize those properties for a specific application. Bridges and pavements constructed of high performance concrete should have a more economical design and/or an extended service life over facilities made with conventional concrete and require less maintenance during that life.

**Savings** - High performance concrete structures and facilities should have lower life cycle costs when compared to those made of conventional concrete. High performance concrete bridges can be designed with fewer members, such as piers or girders, resulting in a savings of material and labor.

**Status** - An HPC for bridges report prepared by the University of Missouri – Columbia, *Instrumentation and Monitoring of High Performance Concrete Prestressed Girders* (RDT01-007), was published in May of 2001. A report on HPC pavement, *Evaluation of Fiber-Reinforced Unbonded Overlay* (RDT00-015) was published in December 2000. Other current HPC projects are an HPC bridge deck on Adelaide Avenue over I-70 in St. Louis City, an HPC bridge deck on Route 291 over Route 150 in Jackson County, and an HPC bridge (girders and deck) on Route 412 in Pemiscot County.

## Ground Penetrating Radar (GPR)

**Purpose** – Ground Penetrating Radar is a non-destructive method of testing various products of highway materials. It has been used by MoDOT to test concrete bridge decks for deterioration, pavement thickness during new pavement construction, pavement layer thicknesses of existing pavements, and to try and determine pavement deterioration.

**Savings** - Substantial savings in cost and destruction of coring pavements, bridge decks and boring in soils, and rock can be accomplished during investigations on highway structures. Used as a quality control device on concrete and asphalt paving, GPR can save coring costs, and destruction plus defects can be caught immediately during construction. Costs of closing lanes of traffic and the safety of not having to have personnel exposed to traffic or motorists subjected to congestion can be realized if high speed GPR acquisition can be attained.

**Status** – Final reports will be completed in fall 2001 on bridge deck and pavement investigation projects. Final reports are available on various other GPR investigations MoDOT has initiated. MoDOT is a member with twenty other states in a pooled fund project called HERMES II. This is a multi-year project to develop a second generation High Speed Electromagnetic Roadway Measurement and Evaluation System, which could re-construct a picture of a pavement or bridge deck in three dimensions, much like a CAT scan and acquire the data at highway speeds. The first phase to come up with a better radar antenna, will be complete in summer 2001 and a decision to make a second prototype will then be made.

## RESEARCH

### SOCIAL, ECONOMIC, ENVIRONMENTAL

## RI00-028 - Cooperative Vehicle Highway Automation Pooled Fund Study (CVHAS)



**Purpose** - The purpose of this project is to promote research, development, testing, demonstration, commercialization and deployment of cooperative vehicle-highway automation systems. The goal of the CVHAS program is to focus attention on the congestion relief promise of CVHAS while also promoting its promise in the field of safety and environmental concerns.



**Savings** - Savings from adoption of CVHAS technology are expected in terms of road user cost and decreased congestion. Savings related to increase safety and crash avoidance are also expected through adoption of various technologies.

**Status** - This pooled fund research project began in July 2000 and includes 11 states, Partners for Advanced Transit and Highways, FHWA, and private sector representatives. CalTrans is the lead agency. Research activities for the first year involve automated docking technologies for transit and shipping, the use of dedicated automated lanes, and the automation of freight container movement in transfer and shipping yards.

## **RI00-047 - Development of Statewide Work Zone Policy**

**Purpose** - This project is designed to establish work zone guidance for construction, maintenance and utility operations on MoDOT right of way, which is based on road user costs and life cycle cost analysis. This project involves determining an acceptable level of road user delay, identifying a measure of delay, and incorporating this guidance into appropriate MoDOT manuals and operations.

**Savings** - The result of this activity will be a reduction in congestion and delays experienced by the traveling public due to maintenance, construction and utility activities on MoDOT right of way. Life cycle cost benefits are also expected as longer lasting material and methods are incorporated into MoDOT facilities to avoid future maintenance activities which would result in traffic delays.

**Status** - This project was initiated in August 2000. A review of current work zone operations, work zone guidance and research, and a review of similar programs in other state DOTs identified as progressive, has been completed. Currently a work zone team has been formed to provide for department-wide input. The work zone team will complete its investigation and policy development activities in fall of 2001.

## **RI00-048 - The Effects of Different Land Uses on Local Fiscal Conditions**

**Purpose** - The purpose of this project is to identify the impacts of changing land uses outside of municipal boundaries on the fiscal condition in that municipality. Growth and annexation of areas outside of a municipal boundaries has often been seen as a means of growth for communities but the results have been mixed. This research will display how the ratio of cost of services compared to tax revenues differs for various communities. MoDOT is participating in this study with the Missouri Departments of Agriculture, Conservation and Economic Development. The Department of Conservation is the lead agency.

**Savings** - No direct savings to MoDOT are expected. This study will provide information for planning and design activities that must increasingly incorporate community and land use variables into their activities.

**Status** - The University of Missouri has formed an advisory team of planning personnel from participating state agencies. This team is identifying communities across the state to be include in case studies.



## RI00-049 - Social and Economic Data Development and Use at MoDOT

**Purpose** - This project is designed to increase the use of social and economic data, such as census data, in the planning and design functions of the department. Based on requests from Planning, Public Affairs and Design units, along with interest and support from the Inspector General's office, census data applications are being developed for use at MoDOT. As a result of this effort, the social and economic data of most use to MoDOT will be identified and a standardized data catalogue made available for users.

**Savings** - No direct savings are anticipated. Incorporating social and economic data into planning and design operations will ensure that the population impacted by the proposed project is identified. Use of this data will also allow for identification of protected or unique subsets of the population that may require additional public involvement efforts or consideration during the design process.

**Status** - A census training and development team has been formed to provide representation of the various work units that could benefit from the use of social and economic data. The University of Missouri will be included in this effort beginning in August of 2001.

## RI01-007 - Development of an Environmental Roadside Inventory Using Spatially Oriented Databases

**Purpose** - The purpose of this project is to develop data collection strategies and mapping tools that result in a planning tool to effectively manage vegetation, mowing and herbicide use on MoDOT right of way. The process developed will also prove valuable for identifying and managing possible environmental impacts associated with future route improvements. Anticipated products include a roadside management tool and training program that can be used by all districts.



**Saving** - Better roadside vegetative management will reduce mowing, herbicide and labor costs. Cost savings also will be realized on future route improvements because portions of the needed environmental data can be drawn from this roadside vegetation management system.

**Status** - Field work is now underway along Route 36 near Hannibal. Data collection strategies are being evaluated and a plant identification catalogue is being developed. Field work will continue throughout the summer and fall months to capture flowering species; while woody species can be catalogued during the winter months. Development of mapping and analysis tools is occurring concurrently.



## TRAFFIC MOBILITY

### RI 00-024 Sign Component Test Deck

**Purpose** - This investigation will determine the proper combination of sign sheeting components to produce visible, durable and economical signs. The emphasis is on ground-mounted sheet signs. Current policy is to use engineering type sheeting background, which has a seven-year warranty. Use of engineering type sheeting is being discontinued to produce signs with a 10-year lifespan. This study will evaluate the compatibility of various manufacturers' components of sign materials including inks, film and sheeting. Missouri is the only state commingling products in sign manufacturing.

**Savings** - This study will determine the proper combinations of components to produce economical, durable and non-fading signs.

**Status** - Test signs were fabricated using various combinations of materials, initial retroreflective readings were determined and signs were placed on the accelerated test deck in spring 2000. Every six months the signs will be inspected for adhesion and/or delamination and retroreflective readings will be taken. The signs will be monitored for one to three years. On May 23, 2001, the one-year inspection was performed.

## DEVELOPMENT

The development emphasis area works with new product development, as well as products we already use. In many instances, RDT may develop products that have already been researched by other states, companies, or universities and refines them for MoDOT's use. By working closely with operations, the development section has numerous opportunities for process improvements.

## SYSTEM PRESERVATION

### PD98-029, Light Weight Aggregate Chip Seal

**Purpose** - The purpose of this study is to determine if the use of a light weight aggregate in maintenance chip seals will reduce the number of claims pertaining to chipped/broken windshields and chipped paint on vehicles. In addition to claim reduction, MoDOT expects adequate durability performance as compared to the standard chip seal.

**Savings** - Savings will be realized from the reduced number of windshield and paint chip claims from aggregate chips being thrown by passing vehicles. Also, increased friction values could provide an unknown savings to the traveling public.

**Status** - The seal was applied in September 1999 on Rte 371 in Platte County. The contractor mistakenly applied almost twice the amount of asphalt oil required to the northbound lane. Subsequently, the entire northbound lane of the project limits requested



extra aggregate. This caused aggregate stacking to occur and resulted in some of the aggregate breaking or the partially bonded particles being pulled out of the seal. The asphalt oil for the southbound lane was applied at the contracted rate. To date, there have not been any claims received from windshield breaks from the chip seal and the entire seal seems to be holding up quite well. Another benefit is the skid numbers obtained from this site were very high. A completion date of October 2004 is scheduled for the evaluation with the final report to follow.

## **PD98-050, Cold Mix Motor Paving**



**Purpose** - The objective of this investigation is to determine if an asphalt cold-mix paving procedure will equal or out perform MoDOT's existing practice of placing cold mix from a windrow. A longer pavement life cycle is needed with a placement process that will be better accepted by MoDOT's

customers. This process will also benefit parts of the state where hot-mix asphalt plants aren't readily available.

**Savings** - A savings was not the driving force behind this project. Two obvious objectives are: Increased customer satisfaction by reducing windrow cold-mix asphalt projects and offering maintenance another option for surface treatments where hot mix plants are not readily available.

**Status** - A test section on Rte. Z in Randolph County was placed in July 2000. After several adjustments to the emulsion formula, the mix finally appeared to be acceptable. It is too early to tell the longevity and durability of this test surface. Regular site inspections will be conducted in the future to determine the short and long term performance of the material. Completion is currently scheduled for September 2005.

## **PD98-055, NovaChip**

**Purpose** - The purpose of this study is to determine if NovaChip, used primarily in urban, high-volume locations, will improve locations where frequent wet accidents occur and provide longer asphalt pavement life cycles. NovaChip is expected to maintain friction values during wet weather due to its open-graded mix. Instead of precipitation draining across the top of the surface, this surfacing will allow precipitation to drain down through the pavement to a liquid membrane. Since moisture is not traveling across the surface to drain, this reduces hydroplaning.

**Savings** - The reduction in wet accidents and improved customer satisfaction is the goal of this project. The material is about twice the cost of a regular one-inch hot-mix surface. However, if the surface performs well in accident reduction, it could be used as a tool for high accident areas.



**Status** - The material has been placed at two locations, the I-29/I-229 north junction, placed in 1998, and another at the I-29/I-229 south junction, placed in 1999. Future locations for 2001 are planned for District 8. Yearly evaluations are currently being performed. Completion of the evaluation is scheduled for October 2003 for the north junction section.

## **PD99-023, Recycled Asphalt Pavement (RAP)**

**Purpose** – The objective of this test is to determine if a recycled cold mix asphalt material could be used as a tool by MoDOT's maintenance operations when patching and surface restoration is needed for low volume routes. A life cycle cost is needed that equals or exceeds the current cold-mix material. If a RAP material can be developed and used successfully by MoDOT's maintenance operations, this will provide a use for MoDOT's cold millings.

**Savings** - Savings will result if RAP can be used successfully in producing a base or pavement for MoDOT. Using RAP would eliminate the need to purchase virgin aggregate to accomplish the same task.

**Status** – MoDOT, District 8 and Koch Materials have placed a surface treatment using millings, crushed and pugmilled to produce a RAP material laid on Rte KK in Laclede County, in August 2000. The first annual review is scheduled for this fall to determine how well the surface held up through the first year. Preliminary reports show that the majority of the surface held up well, with only a few areas that needed repair. This was due to the lack of a surface seal that was needed, after the RAP material was laid.

## **DEVELOPMENT**

### **INNOVATION**

## **PD97-018, Ground Speed Control**

**Purpose** - Originally, this project was to try to regulate the amount of salt brine being applied based on ground speed of the vehicle versus a gravity-fed dispensing system and to determine the effectiveness of a liquid de-icing system. The project was expanded to include ground speed for salt application as well. The goal of this investigation is to determine the effectiveness of a ground speed control system versus a gravity fed, non-ground speed control dispensing system.

**Savings** - Cost savings should be realized in the reduction of the amount of salt and brine applied compared to MoDOT's conventional spreaders. Savings will vary statewide depending on the amount of salt per mile currently applied with conventional spreading equipment versus using ground speed control. Also, a hidden benefit, such as a reduction in the deterioration of roadways and structures from chlorides, may be evident.

**Status** - The original project was actually closed but there has been enough interest generated, due to the ground speed units General Services has been purchasing, to warrant further investigation. A report has been prepared and submitted to MoDOT's Maintenance.



# DEVELOPMENT

## SAFETY

### PD 00-020 and 00-021 Rohm Haus HD21 and Dow DT 400 Pavement Marking Material

**Purpose** – District 7 is interested in improving the waterborne paint stripe material being placed by District 7 strippers. Currently MoDOT uses second-generation resins in the waterborne paint. The Rohm Haus HD21 and Dow DT 400 pavement marking material products are waterborne striping paint material with 4<sup>th</sup> generation resins.

**Savings** - These products may improve the durability and quality for future striping.

**Status** – The material was placed in October 2000. The project has a tentative 12-month evaluation period. The six-month evaluation was performed in April 2001.

### Midwest States Pooled Fund Program

**Purpose** - Since 1990, MoDOT has been a member of this regional crash testing pooled fund. The purpose is to provide a safer road through the testing and evaluation of roadside safety appurtenances to assure they meet FHWA and industry requirements and standards. Also, the pooled fund program eliminates duplication in testing and evaluation by member states.

**Savings** - The savings attributed to the program may not be monetary to MoDOT except in eliminating testing duplication, but may be more in the reduction of accidents and injuries associated with impacting MoDOT roadside safety hardware. This should decrease MoDOT's liability costs.

**Status** - The pooled fund program is an ongoing program with yearly testing programs established and approved by the technical committee at its yearly meeting.

### Workzone Quality Circle

**Purpose** - This team is composed of representation from Operations, Construction, Design, Maintenance, Traffic, RDT and FHWA. The QC handles all aspects of MoDOT workzone (contract and maintenance) standards and policy. The QC reviews workzone devices, implement FHWA mandates associated with workzones and deals with any other items associated with department workzones. The QC performs workzone audits on three or four districts each year so that each district is visited every three years. The group answers to an oversight committee that consists of directors and state engineers.

**Savings** - Monetary savings are not considered directly when discussing workzone safety and implementation.

**Status** - This is an ongoing quality circle that deals with day-to-day workzone operations, policy and standards, and mandates associated with workzones.

## **POOLED FUND STUDIES**

### **AASHTO**

The AASHTO supports a series of research studies, which are considered of national interest. Topics range from software development to the support of SHRP product implementation. As an AASHTO member department, MODOT participates in funding these pooled fund studies with 80% SPR and 20% state funds.

### **Current Continuing Studies**

Environmental Technical Assistance Project (ETAP)  
HWYCON Knowledge System for Concrete Pavement Rehabilitation  
National Transportation Product Evaluation Program (NTPEP)  
AASHTO Task Force (Senior Level Steering Group (SICOP)  
Strategic Highway Safety Plan  
National Workzone Information Clearinghouse

### **NATIONAL AND REGIONAL**

MoDOT joins with other states and the FHWA in the support of several research investigations of mutual interest and specialized research centers. These studies are funded with 100% SPR.

### **Commitments FY 1999-2001**

National Cooperative Highway Research Program (NCHRP)  
Macro Surface Mix Design – KDOT  
Wind Induced Vibration of Cable Stayed Bridge – MoDOT  
Updating a Guide to Standardized Highway Lighting Pole Hardware – WyDOT  
National Incentive to Develop and Advance Bridge Deck  
Inspection Technique – (Hermes II) – FHWA  
Regional States Pooled Fund Crash Test Program - NeDOR  
North Central Superpave Center – Purdue University (FHWA)  
Accelerated Testing Facility – KDOT  
Smart Workzone Initiative – NeDOR  
FIXS: Fabrication Error Indexed Examples and Solutions – KDOT  
Traffic Management Consortium – FHWA  
Enhanced Guidance for Implementation of Safety Strategies – FHWA  
Cooperative Vehicle Highway Automation System (CVHAS) – Cal Trans  
Treasure Island Liquefaction Tests (TILT) - CalTrans



# TECHNOLOGY TRANSFER

After a product has been research and developed, information is shared within the department, state and the country. Technology transfer uses many tools to share information internally and externally. Technology sharing methods include research reports, letters of findings, briefs, guidesheets, newsletters and training workshops.

## Technology Transfer Assistance Program (TTAP)

**Purpose** - TTAP's objective is to coordinate the transfer of transportation research technology, development and other technology initiatives. Reorganization at MoDOT has structured TTAP as part of the Research, Development and Technology unit. The reorganized structure was designed to complement both the Local Technical Assistance Program and Technology Transfer with the department. The RDT Strategic Plan provides a focus and direction by establishing goals and objectives for consideration of both internal and external environments of the department. Emphasis areas have been identified to assist with technology dissemination and the research project program.

**Savings** – Savings are accomplished by sharing one common goal “to enhance a quality transportation system.” Savings can be realized by using similar strategies for technology, both internal and external to MoDOT.

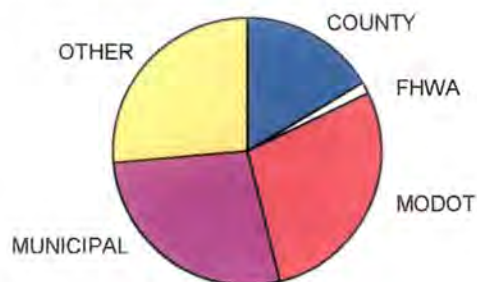
**Status** – This is an annual program.

## Information Requests

*(Information Shared with Customers by Category)*

| Requester                                    | Requests      | Total *<br>Distributed |
|--|---------------|------------------------|
| County                                       | 3085          | 3145                   |
| FHWA   | 256           | 267                    |
| MoDOT  | 1513          | 5446                   |
| Municipal                                    | 4909          | 5308                   |
| Other (Universities, Consultants and Others) | 4162          | 5073                   |
| <b>Total</b>                                 | <b>13,925</b> | <b>19,239</b>          |

\* Total distribution includes several copies of a report.



## Technology Sharing

**Purpose** – The RDT Division has established several goals to foster technology transfer to promote effective use of technology, research and new product findings. This has been accomplished through RDT Briefs, Brochures, Research Reports, Conference Booths and Technology Scanning.

**Savings** – Savings are realized as new technology and findings become a part of the department and local jurisdiction processes.

**Status** – Technology sharing is an annual effort.

### Technology Sharing

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#### *Published/Shared in Fiscal Year*

|                  |   |    |
|------------------|---|----|
| Research Reports | - | 14 |
| Briefs           | - | 14 |
| Brochures/Videos | - | 16 |
| Newsletters      | - | 6  |

## Technology Scanning

**Purpose** – The RDT Division is the focal point for FHWA/State research reports, new products, and innovative technology. This information is scanned to provide to the appropriate end user.

#### *Technology Scanning To:*

|                                   | <i>Number</i> |
|-----------------------------------|---------------|
| Bridge                            | 15            |
| Bridge Maintenance                | 5             |
| Chief Council                     | 5             |
| Construction                      | 9             |
| Design                            | 10            |
| Districts 1-10                    | 0             |
| General Services                  | 0             |
| Human Resources                   | 1             |
| Information Systems               | 1             |
| Materials                         | 30            |
| Multimodal Operations             | 8             |
| Maintenance                       | 13            |
| Planning                          | 7             |
| Resource Management               | 1             |
| Right-of-Way                      | 1             |
| Transportation Management Systems | 3             |
| Traffic                           | 13            |
| Technical Review Committee        | 32            |



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| Materials                         | 30            |
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| Maintenance                       | 13            |
| Planning                          | 7             |
| Resource Management               | 1             |
| Right-of-Way                      | 1             |
| Transportation Management Systems | 3             |
| Traffic                           | 13            |
| Technical Review Committee        | 32            |

## RDT Training Activities

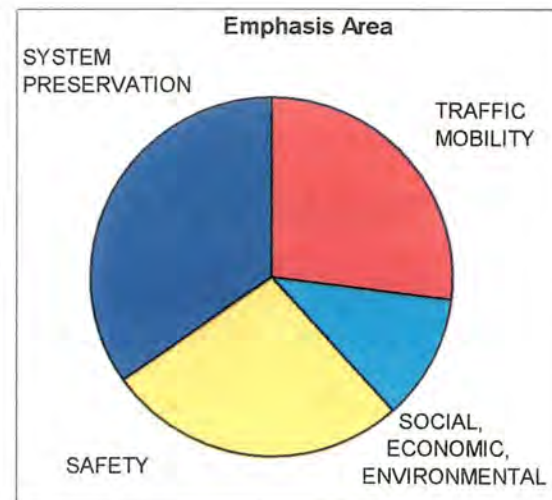
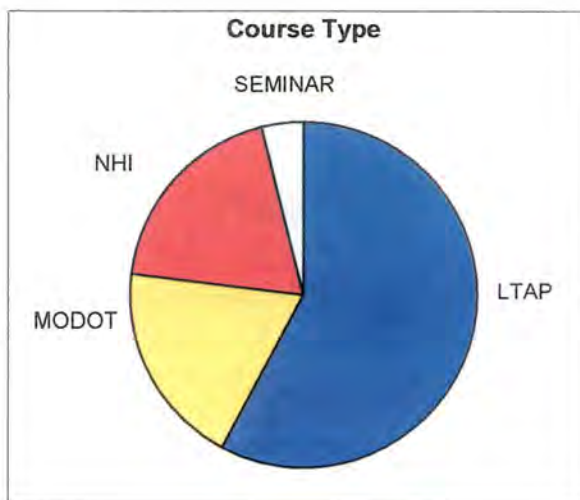
**Purpose** – Technical training courses are available to provide direction and support to personnel. These courses are scheduled to maintain an understanding of new methodologies, technologies, and best practices. Training is provided to meet requested needs and enhance abilities to support the overall transportation function. The audience includes department of transportation and local transportation agencies. Training is further accomplished by field assistance demonstration which depict a hands on, best practices method of sharing.

**Savings** – Significant savings can be realized as courses are scheduled at locations to minimize or eliminate travel time. Savings can also be realized through partnering at the department and local level to maximize logistics.

**Status** – Training is an annual effort.

## TRAINING

| Course Type  | Number    | Traffic Mobility | Social Economic Environmental | Safety   | System Preservation | Innovation |
|--------------|-----------|------------------|-------------------------------|----------|---------------------|------------|
| TAP          | 15        | 4                | 0                             | 6        | 5                   | 0          |
| MODOT        | 5         | 3                | 1                             | 0        | 1                   | 0          |
| NHI          | 5         | 0                | 2                             | 0        | 3                   | 0          |
| SEMINARS     | 1         | 0                | 0                             | 1        | 0                   | 0          |
| <b>TOTAL</b> | <b>26</b> | <b>7</b>         | <b>3</b>                      | <b>7</b> | <b>9</b>            | <b>0</b>   |





## **Local Technical Assistance Program (LTAP)**

**Purpose** – LTAP provides transportation information and training opportunities to local city and county transportation agencies. Technical materials are distributed, field and office assistance is provided to local transportation agencies. Special projects are handled on a need versus resources available basis. Communications are maintained via quarterly newsletter mailings.

## **High Accident Location Manual Update**

**Purpose** – This contracted study reviewed the methodology for identification analysis and correction of high-crash locations. Particular emphasis was placed on revising accident reduction factors, regression-to-the-mean (r-t-m) incorporation, safety management systems/Missouri Traffic Information System (MOTIS) coordination and establishment of monetary values of accident types (i.e. fatal, injury, and property damage only).

**Savings** – Savings will be realized through an easy-to follow user guide to apply safety management for identification and analysis of high accident locations.

**Status** – Completed January 2000.

## **Bridge Engineering Assistance Program (BEAP)**

**Purpose** – This program assists cities and counties to analyze the structural adequacy of bridges on their local roads systems. Consultant structural engineering expertise is used, which includes bridge inspection experience, development of bridge maintenance priorities and low cost bridge improvement strategies. LTAP supplements Federal 402 Safety Funds to maintain an annual effort.

**Savings** – Savings can be realized by fewer bridge closings that cause detours, by uniform maintenance efforts and by rehabilitation projects in lieu of new construction.

**Status** – BEAP is an annual program in partnership with the Missouri Division of Highway Safety.

## **Traffic Engineering Assistance Program (TEAP)**

**Purpose** – This program assists cities and counties in solving traffic-engineering problems. Engineering consultants may be used to review operational problems encountered at the local jurisdiction. LTAP supplements Federal 402 Safety Funds to maintain annual effort.

**Savings** – Savings can be realized by a uniform analysis of solving traffic-engineering problems.

**Status** – TEAP is an annual program in partnership with Missouri Division of Highway Safety.

## **Cooperative Procurement Program**

**Purpose** – Joint purchasing and centralized procurement is available to political subdivisions in Missouri. LTAP Provides regular updates to inform city and county officials of current bid items and contacts.

**Savings** – Volume buying can mean lower procurement cost for public sector participants. Improved specifications and indirect savings are realized by eliminating administrative duplication of reading, evaluating and awarding bids.

**Status** – Annual program.



## **Research, Development & Technology**

**Task and Activities June 2000 – July 2001**

### **TA NUMBER**

### **TA REQUEST TITLE**

|          |   |
|----------|---|
| TA00-021 | Development of Portable Scour Equipment                           |
| TA00-022 | Ecological Mitigation   |
| TA00-023 | Guidelines for Curbs and Curb Barrier Combinations                |
| TA00-024 | Partnerships in Transportation                                    |
| TA00-025 | Long Term Pavement Marking Practices                              |
| TA00-026 | Geosynthetic Reinforcement in Roadway Systems                     |
| TA00-027 | Corrosion in the Environment: Soil Resistivity and pH Measurement |
| TA00-028 | Centerline Rumble Strips  |
| TA00-029 | Asphalt Crack Sealing/Filling Practices                           |
| TA00-030 | Safety of Recessed Pavement Markings for Motorcyclist             |
| TA00-031 | Standards for Superelevations                                     |
| TA00-032 | Mid-panel Cracking of Jointed Concrete Pavement                   |
| TA00-033 | Permeable Bases   |
| TA00-034 | Growth in Contract Costs  |
| TA00-035 | Research Performance Measures                                     |
| TA00-036 | Longitudinal Profiling  |

## **Research, Development & Technology**

**Task and Activities June 2000 – July 2001**

| <b>TA NUMBER</b> | <b>TA REQUEST TITLE</b>  |
|------------------|--|
| TA00-037         | Use of Flexible Guideposts   |
| TA00-038         | Concrete Maturity  |
| TA00-039         | Corrosion of Metals above the Ground Surface: Transportated Related Issues |
| TA00-040         | Superpave 2000 Lessons Learned   |
| TA00-041         | Deck Cracking on Bridge A5554, Osage County                                |
| TA00-042         | Steel Diaphragms on Concrete I-Beams and Bulb – Tee Beams                  |
| TA00-043         | GIS and GPS/PTT Telemetry Study of Deer Behavior                           |
| TA00-044         | Minimizing Construction Related Congestion                                 |
| TA00-045         | Wetlands Issues for Wetlands   |
| TA00-046         | Computerized Sign Inventory Management System                              |
| TA01-001         | Nighttime Construction and Maintenance                                     |
| TA01-002         | Anti-Litter Programs   |
| TA01-003         | Work Zone Safety – Slow Moving Operations                                  |
| TA01-004         | Systems Engineering Processes for Developing Traffic Signal Systems        |
| TA01-005         | Survey on Cement Processing Additions                                      |
| TA01-006         | Peer Exchange  |



# Research, Development & Technology

## Task and Activities June 2000 – July 2001

| <b>TA NUMBER</b> | <b>TA REQUEST TITLE</b>  |
|------------------|--|
| TA01-007         | UMC MoDOT Job Staff Sharing Proposal   |
| TA01-008         | Solicitation of Proposals for Project Funding  |
| TA01-009         | Survey on State DOT/UTC Interaction  |
| TA01-010         | State Funding Distribution Request   |
| TA01-011         | How Do Other States Assess Liquidated Damages  |
| TA01-012         | Culvert Practices Questionnaire  |
| TA01-013         | Vehicle Collisions with Highway Bridges  |
| TA01-014         | Arrow Panel Displays during Mobile Maintenance Operations  |
| TA01-015         | MOTREC/MODOT Biannual Meeting  |
| TA01-016         | Assessment and Recommendations on Pre-Mature Deck Cracking   |
| TA01-017         | Preparation of Executive Summary for Continuously Reinforced Concrete Pavement (CRCP)  |
| TA01-018         | Preparation of Executive Summary on Longitudinal Tining of PCCP  |
| TA01-019         | Air-void Analysis of Structural Concrete Pier Cap  |
| TA01-020         | Preparation of Executive Summary of Diamond Grinding PCCP  |
| TA01-021         | Observations and Field Data Collection Concerning the Performance of Iowa F-shaped Temporary Barrier for MSRPF Crash Testing Program |

# **Research, Development & Technology**

**Task and Activities June 2000 – July 2001**

## ***TA NUMBER***

## ***TA REQUEST TITLE***

TA01-022

Pavement Data Condition Evaluation  
I035 Daviess County

TA01-023

Initiate Lead Effort for Fiber  
Reinforced Polymers (FRP) Initiative  
Plan

TA01-024

Compilation of Other States Data on  
Maintenance Investment per Mile



**Technology Transfer Assistance Program**  
**"Technology Sharing"**  
**FY 2001**

| <u>TITLE</u>   | <u>RESEARCH<br/>REPORT</u>    | <u>RDT BRIEF</u> |
|--|-------------------------------|------------------|
| Slope Stabilization Using Recycled Plastic Pins<br>Constructability (RI 98-007) (UMC)  | Report, 2000                  |                  |
| Pavement Marking Management System - Phase 1   | RDT 00-008<br>August, 2000    |                  |
| Evaluation of Undersealing and Diamond Grinding<br>Rehabilitation (RI 86-002, RI 96-017)   | RDT 00-009<br>August, 2000    |                  |
| Evaluation of Temperature Sensors as a Tool to Aid in<br>Compaction of Superpave (PD 98-051)   | RDT 00-010<br>August, 2000    | August, 2000     |
| Warning Lights on Missouri Department of Transportation<br>Vehicles (RI 97-006)  | RDT 00-011<br>September, 2000 |                  |
| Pavon Indeck Crack Sealer Evaluation<br>(RI 96-005)  | RDT 00-012<br>September, 2000 | September, 2000  |
| An Automated Imaging System in Concrete Analysis<br>(RI 98-006)  |                               | September, 2000  |
| Evaluation of SHRP Products and Other Non-Destructive<br>and Test Equipment for Pavement, Pavement Thickness<br>Bridge Deck Applications (RI 94-006)                           | RDT 00-013<br>September, 2000 |                  |
| Analysis of PCC Pavement Rehabilitation in Missouri<br>(Review of the Performance of Long-Term Pavement<br>Performance Test Sections to Date) (RI 99-023<br>(ERES Consultants) | September, 2000               | February, 2001   |
| RDT Combination Bulletins - TechTran (Vol. 16, No. 3)<br>and Quarterly (Vol.4, No. 1)  | November, 2000                |                  |
| Construction Report - US Hwy.36 - SuperPave Overlay<br>of Sand Anti-Fracture Layer Over AC/PCC Pavement (RI 99-042)  | December, 2000<br>RDT 00-001B | February, 2001   |
| Fiber-Reinforced PCC Unbonded Overlay (I-29 Atchison<br>County - Performance Update) (RI 97-015)   | RDT 00-015<br>Report, 2000    | January, 2001    |
| Experimental Testing and Monitoring of a FRP Bridge<br>(RI 98-032) (UMR)   | December, 2000<br>RDT 00-016  |                  |
| SuperPave 2000 Construction Season: Lessons<br>Learned (TA 0-040)  | RDT 00-017<br>December, 2000  |                  |

**Technology Transfer Assistance Program**  
**"Technology Sharing"**  
**FY 2001**

| <u>TITLE</u>  | <u>RESEARCH<br/>REPORT</u>                             | <u>RDT BRIEF</u> |
|---|--|------------------|
| Application of Sand Anti-Fracture (SAF) Layer of<br>Pavement Rehabilitation (97-045 & 99-042)   | RDT 00-001, 001B<br>01- March, 2000<br>01B - Dec, 2000 | February, 2001   |
| The Missouri Department of Transportation Research,<br>Development and Technology Program Technical<br>Advisory Groups  |  | February, 2001   |
| Destructive and Non-Destructive Testing of Bridge J857,<br>Phelps County, Missouri - Volume I - Strengthening<br>and Testing to Failure of Bridge Decks (RI 98-013)<br>(UMR / UMC)                            | RDT 01-002A<br>April, 2001                             |                  |
| Destructive and Non-Destructive Testing of Bridge J857,<br>Phelps County, Missouri - Volume II - Feasibility Study<br>on Damage Detection of RC Structures Using Dynamic<br>Signature Tests (RI 98-013) (UMR) | RDT 01-002B<br>April, 2001                             |                  |
| Destructive and Non-Destructive Testing of Bridge J857,<br>Phelps County, Missouri - Volume III - Strengthening<br>and Testing to Failure of Bridge Piers (RI 98-013) (UMR)                                   | RDT 01-002C<br>April, 2001                             |                  |
| Water Reducing Admixtures in PCCP Mixes (RI 00-01)<br>(RDT)   | RDT 01-004<br>March, 2001                              | April, 2001      |
| Metallic Dampers for Seismic Design and Retrofit at<br>Bridges  | RDT 01-005<br>May, 2001                                |                  |
| Investigation of Agents of Practical Use to Stabilize Slopes<br>and Erosion Along the I-55 Corridor South of Sikeston, Mo<br>(RI 99-030) UMR  | RDT 01-006<br>May, 2001                                |                  |
| Instrumentation and Monitoring of High Performance<br>Concrete Prestressed Bridge Girders RI 97-036   | RDT 01-007<br>September, 2001                          |                  |
| Pre-Cast I Girder Cracking: Causes and Design Details<br>(RI 97-021) UMR-UMC  | RDT 01-008<br>June, 2001                               |                  |
| Earthquake Hazard Assessment Along Designated<br>Emergency Vehicle Priority Access Routes (RI 98-43) (UMR)  | RDT 01-009   |                  |
| Evaluation of Early Entry Sawing of PCC Pavement<br>(RI 99-033)   | RDT 01-010<br>August, 2001                             | September, 2001  |



**Technology Transfer Assistance Program**  
**"Technology Sharing"**  
**FY 2001**

| <u>TITLE</u>  | <u>RESEARCH<br/>REPORT</u> | <u>RDT BRIEF</u> |
|---|----------------------------|------------------|
| Safety and Design Improvements at Rural<br>Expressway Median Crossovers (Phase 1) (RI98-009)<br>Note: RDT No. updated from 01-001 to 01-011 | RDT 01-011                 |                  |
| Bridge Deck Condition Studies in Missouri Utilizing Ground<br>Penetrating Radar (RI 98-001)   | RDT 01-012<br>August, 2001 |                  |
| Strengthening of an Impacted PC Girder on Bridge A10062,<br>St. Louis County, Missouri (RI 99-041) (UMR)<br>NOTE: Updated from 003-013      | RDT 01-013                 |                  |
| Automated Pavement Analysis, Best Equipment,<br>Test Methodology (RI 98-002) UMR  |                            |                  |
| Limited Distribution  |                            |                  |
| Distributed   |                            |                  |
| Future Distribution   |                            |                  |

**MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT**

**RESEARCH IDEA STATEMENT**

Research Idea Statements are being solicited under research emphasis areas: For example:  
(A) Safety, (B) Maintenance, (C) Structures, (D) Traffic, etc.

**RESEARCH:**

*(attach additional sheets if necessary)*

**Idea Title:**

**Idea Statement:**

**Objective:**

**(Optional)**

**Emphasis Area:**

**Application or Research Results:**

**Pertinent Divisions:**

**Key Words** (Key words are needed to assist in literature search for Research Idea subject):

Name:

Date:

Title:

Organization:

Div/Dist.:

Address:

Phone:

Complete and return to:

Missouri Department of Transportation  
Attn.: Research, Development & Technology  
P.O. Box 270  
Jefferson City, Missouri 65102

Phone: (573) 751-3002

FAX: (573) 526-4337



MISSOURI DEPARTMENT OF TRANSPORTATION  
**RESEARCH, DEVELOPMENT AND TECHNOLOGY DIVISION**

NEW PRODUCT EVALUATION REQUEST

|  |               |               |
|--|---------------|---------------|
| Product:   | Product No.   |               |
| Manufacturer:                                    | Address:      |               |
| City:  | State:        | Zip:          |
| Manufacturer Contact:                            | Telephone No. | Telephone No. |
| Description and Intended Application of Product: |               |               |

Pertinent Divisions:

Key Words (requested for literature search):

|                           |                 |                       |
|---------------------------|-----------------|-----------------------|
| Does Product Comply with: | <u>(Yes/No)</u> | <u>(Spec. Number)</u> |
| MODOT Specifications:     |                 |                       |
| AASHTO Specifications:    |                 |                       |
| ASTM Specifications:      |                 |                       |

Other states using proposed product:

Will manufacturer furnish samples for laboratory evaluation?

Will manufacturer provide material at no cost for trial field installation and evaluation?

Documentation Required:

1. Product Data Sheet detailing properties, mixing requirements, installation requirements, etc.  
(if not included with the data sheet, attach a copy of the requirements.)
2. Material Safety Data Sheet for the product.
3. If material is submitted for compliance with MODOT Specification, submit the specified documentation set forth in the respective specification.
4. Submit any test data available on the product.

Submit this form with required documentation to:

State Research, Development and Technology Engineer  
Missouri Department of Transportation  
P.O. Box 270  
Jefferson City, MO 65102

Requested product samples shall be sent to:

Materials Laboratory  
ATTN: RD & T  
1617 Missouri Boulevard  
Jefferson City, MO 65109

## Missouri Department of Transportation



Research, Development and Technology  
P.O. Box 270  
1617 Missouri Blvd.  
Jefferson City, MO 65109  
(573) 751-3002

<http://www.modot.state.mo.us>

September 2001



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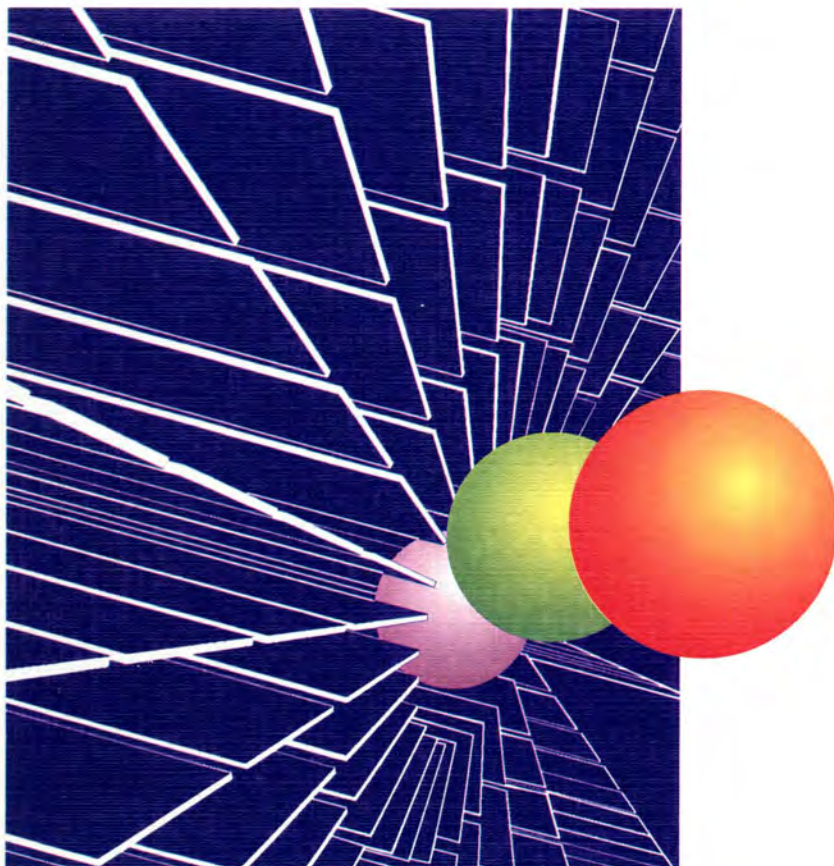
Research, Development and Technology

University of Missouri-Columbia

RDT 00-007

# Slope Stabilization Using Recycled Plastic Pins - Constructability

RI 98-007



July, 2000